Forensic Examination of Australian Papers Using Isotope Ratio Mass Spectrometry

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PhD Thesis: Science

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2016

CERTIFICATE OF ORIGINAL AUTHORSHIP

I certify that the work in this thesis has not previously been submitted for a degree nor has it been submitted as part of requirements for a degree except as fully acknowledged within the text.

I also certify that the thesis has been written by me. Any help that I have received in my research work and the preparation of the thesis itself has been acknowledged. In addition, I certify that all information sources and literature used are indicated in the thesis.

Signature of Student:

Date:

ACKNOWLEDGEMENTS

I would firstly like to express my appreciation and thanks to my role model, mentor and supervisor Dr Sarah Benson, without whom I would not have been able to do this. Your constant support, patience and knowledge has been pivotal in providing the framework for me to become the forensic scientist and leader I am. Thank you!

To my UTS supervisor Claude Roux, thank you for supporting this project and providing a consistent source of encouragement and guidance in all things academic.

To the AFP Document Sciences team – in particular Rochelle Epple and Katrina Stokes – thank you for supporting me over the course of this project. I know it has put more pressure on you all in a number of ways (including having an absent, distracted or cranky team leader!) and I appreciate the support more than you know. Thank you also to Timothy Simpson who put up with my endless questions, complaints, blonde moments and general isotopic chatter.

Most importantly - to my family! Words cannot describe how lucky I feel to have you all. You taught me from an early age that I could achieve anything I put my mind to which is an amazing place to start. To my Darr, you were right – one small step at a time – you just forgot to mention how many steps there were in finishing this PhD! To Mum, Rachael and Tanya – thank you for always being proud of me and inspiring me to keep pushing. To my fur-baby Atticus – thank you for keeping my lap warm and for distracting me endlessly over the last three years. And finally, the biggest thank you is to my husband Ben, who lived with me from the first to the final day of my PhD. You never once doubted my ability to complete this research, even through my most emotional moments!

A big thank you also needs to be given to colleagues and students that have assisted with preparation of standards and samples or physical measurements over the life of this project. Timothy Simpson, Felicity Koens, Rochelle Epple, Alexandra Cameron, and Szymon Dzubinski – thank you!

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ABSTRACT

Isotope Ratio Mass Spectrometry (IRMS) has been shown to be a useful tool in the comparison of materials that are chemically identical or have been naturally produced. Based on this, and noting the capability gaps within the Forensic Document Examination field, the measurement of carbon and oxygen isotopic abundance values using IRMS has been developed as a technique for the examination of document papers. Through validation of the inter- and intra-ream variability of papers, appropriate guidelines for comparison and discrimination have been constructed, to ensure the technique is robust and accurate. Through the measurement of a background population of 125 papers, 89% of samples collected from within Australia and New Zealand were discriminated using pair-wise comparisons.

The IRMS results were placed in a broader context, through the use of a range of light, physical and chemical techniques. Based on these results, an examination and interpretation protocol was defined and tested through the use of a range of scenarios in a blind trial. All results within the blind trials were correct, demonstrating that the examination, comparison and reporting structure defined was accurate, robust and fit for purpose. As a result of this project, a paper examination protocol which is operationally relevant to Australian law enforcement has been developed and validated and is ready for use in forensic casework examinations.

LIST OF PUBLICATIONS AND PRESENTATIONS

The following is a list of publications relating to this research. A copy of each of these articles is included electronically within Appendix 5.

K. Jones, S. Benson, C.Roux, *The forensic analysis of office paper using carbon isotope ratio mass spectrometry, Part 1: Understanding the background population and homogeneity of paper for the comparison and discrimination of samples,* Forensic Science International, 2013, Vol 231(1), 354-363.

K. Jones, S. Benson, C.Roux, *The forensic analysis of office paper using carbon isotope ratio mass spectrometry, Part 2: Method Development, validation and sample handling,* Forensic Science International, 2013, Vol 231(1), 364-374.
Winner – *National Institute of Forensic Science, Best Technical Article or Note, 2014*

K. Jones, S. Benson, C.Roux, *The forensic analysis of office paper using carbon isotope ratio mass spectrometry, Part 3: Characterising the source materials and the effect of production and usage on the* $\delta^{13}C$ *values of paper,* Forensic Science International, 2013, Vol 233(1-3), 355-364.

K. Jones, S. Benson, and C. Roux, *The forensic analysis of office paper using oxygen isotope ratio mass spectrometry. Part 1: Understanding the background population and homogeneity of paper for the comparison and discrimination of samples*, Forensic Science International, 2016, Vol 262, pp.97-107.

The following is a list of conferences that this research has been presented at:

Forensic Isotope Ratio Mass Spectrometry Conference, 2010, Washington DC – Poster

Australian and New Zealand Forensic Science Society Conference, 2010, Sydney – Oral Presentation

European Association of Forensic Science, 2010, The Hague – Oral Presentation

Australian and New Zealand Forensic Science Society Conference, 2012, Hobart – Oral Presentation, *Winner – Best Oral Presentation in Document Examination*

Forensic Isotope Ratio Mass Spectrometry Conference, 2013, Montreal – Oral Presentation

American Society of Questioned Document Examination/ Australasian Society of Questioned Document Examination Joint Meeting, 2014, Honolulu – Oral Presentation

Australian and New Zealand Forensic Science Society Conference, 2014, Adelaide – Oral Presentation

European Association of Forensic Science, 2015, Prague – Poster Presentation

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